The Twin Hypothesis of Education and Retirement

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KEY QUESTION: *Is it reasonable to consider both the individual education and the individual retirement decision within the same macroeconomic model?*

Motivation

Higher old-age life-expectancy affects retirement patterns. Vogel et. al. (2010) also suggest that effect of aging on human capital accumulation (education) is substantial. Yet few models exist which allow for endogenous schooling and retirement at the same time.

Starting point of the analysis:

- Heijdra and Romp. Human capital formation and macroeconomic performance in an ageing small open economy. *J. Econ. Dyn. Control*, 2009
- Heijdra and Romp. Retirement, pensions, and ageing. *J. Public Econ.*, 2009

Objectives

Heijdra and Romp consider education and retirement in **separate** papers. Therefore, I

- combine the two models into a joint model which allows for endogenous schooling **and** retirement

and study

- how individual behavior differs from the original papers;
- how the dynamics of aggregate variables are affected.

Model setup

I. Individuals

- continuous time overlapping generations model
- age-dependent mortality rate, $m(u,\psi)$
- each cohort v maximizes lifetime utility w.r.t.
  - time path of consumption
  - schooling time, $e(v)$
  - retirement age, $R(v)$
- individuals receive
  - education subsidy while in school
  - wage during working life
  - pension after retirement

Wages and pensions depend on **individual human capital**, defined as

$$\bar{h}(v) := \begin{cases} 0 & \text{for } 0 \le u < e(v), \\ A_H h(v)^{\phi} e(v) & \text{for } u \ge e(v), \end{cases}$$

where $0 \le \phi \le 1$.

- $h(v)$ is economy-wide per capita human capital at date v
- $\phi > 0$: **intergenerational knowledge spillover**

II. Aggregate economy

Per capita human capital is the crucial variable of the model. It is a weighted average of *individual human capital* of the working generations, i.e.

$$h(t) := \int_{-\infty}^{t} \mathbf{1}\{e(v) \le t - v < R(v)\}\, \bar{h}(v)\, l(v,t)\, dv$$

where $\bar{h}(v) = A_H h(v)^{\phi} e(v)$ is individual human capital of cohort v. This is a non-linear Volterra integral equation of the second kind.

Results: The impact of population aging

Study a reduction in *adult mortality* in three different model specifications:

1. **education model:** schooling time endogenous, retirement age exogenous.
2. **retirement model:** retirement age endogenous, schooling time exogenous
3. **full model:** schooling time **and** retirement age endogenous

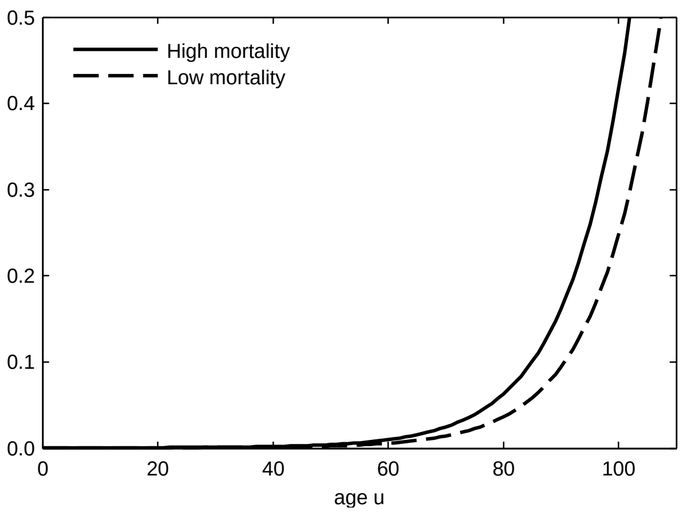

Fig. 1: *Mortality rate $m(u,\psi)$ for two levels of ψ*

I. Comparative static analysis

Assume $\partial m(u,\psi)/\partial\psi \le 0$, i.e. an increase in ψ reduces adult mortality (see Fig. 1).

In the full model, **individual response** in schooling and retirement are positive and stronger than in the sub-models:

$$\frac{\partial e^*}{\partial \psi} > \left.\frac{\partial e^*}{\partial \psi}\right|_{R=R^*} > 0 \quad \text{and} \quad \frac{\partial R^*}{\partial \psi} > \left.\frac{\partial R^*}{\partial \psi}\right|_{e=e^*} > 0.$$

The **aggregate effect** of aging on long-run per capita human capital, h^{SS}, is ambiguous:

1. two positive behavioral effects (higher e^* and R^*)
2. one negative demographic effect (share of working generations decreases)

Still, in the full model the effect of aging is higher than in both sub-models:

$$\frac{\partial h^{SS}}{\partial \psi} > \left.\frac{\partial h^{SS}}{\partial \psi}\right|_{e=e^*} \quad \text{and} \quad \frac{\partial h^{SS}}{\partial \psi} > \left.\frac{\partial h^{SS}}{\partial \psi}\right|_{R=R^*}.$$

II. Numerical results

Life exp. rises from 76.6 to 82.3 years (7.4%).
Remaining life exp. at age 60 increases by 22.6%.

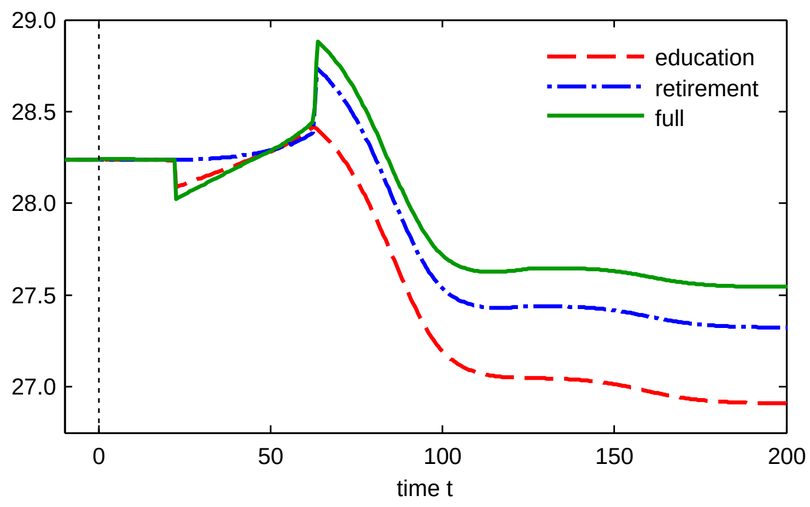

Fig. 2: *Time path of per capita human capital $h(t)$*

Scenario	h^{SS}	%-change in h^{SS}
initial steady state	28.2	—
uncontrolled	26.8	–5.0%
education	26.9	–4.8%
retirement	27.3	–3.3%
full model	27.5	–2.5%

Table 1: *Comparison of long-run effects*

⇒ Per capita human capital of the full model outperforms both sub-models after 50 yrs (Fig. 2).

⇒ In the full model, **half of the negative demographic effect is compensated** by the altered individual behavior.

⇒ **The negative impact of aging on human capital (and thus output) is overestimated by 32%** if we do not control for e and R at the same time (since $3.3/2.5 - 1 = 0.32$).

Lessons to be learned.

Neglecting the interaction in education and retirement decisions may result in wrong expectations about the quantitative effects of demographic shocks and policy reforms. The model predicts that by not controlling for both variables simultaneously:

⇒ The negative impact of **population aging** on output is **overestimated by 31.6%**.

⇒ The effect of a **reduction of old-age working disutility** is **underestimated by 11.3%**.

⇒ The effect of an **education reform** (20% increase of the schooling subsidy) is **underestim. by 49.2%**.

⇒ The effect of a **pension reform** (10% reduction of the accrual rate) is **underestimated by 5.2%**.

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